

Small Cubic Type

5.0 Mega Pixel CCD

Monochrome PoCL Camera Link Camera

FV-L500B1

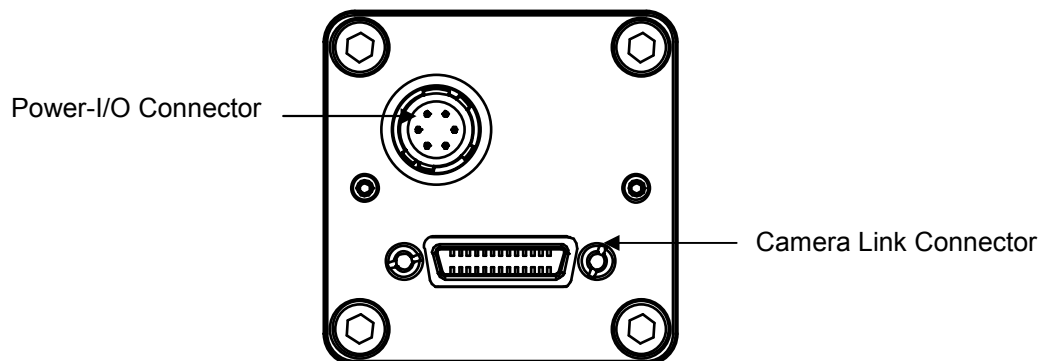
User's Guide

RICOH COMPANY, LTD.

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## 1 Connector Specifications



### 1.1 Camera Link Connector

SDR (3M) or equivalent

**This product is a PoCL type.**

**When a frame grabber is PoCL compliant, DO NOT SUPPLY POWER FROM THE I/O CONNECTOR.**

**When a frame grabber is NOT PoCL compliant, supply power from the I/O connector.**

#### Pin Assignment

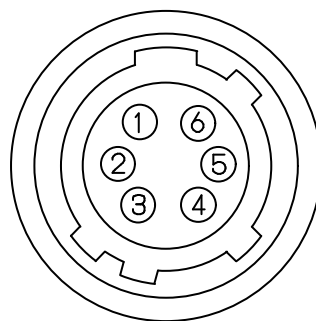
Pin No.	Signal Name	Pin No.	Signal Name
1	+12V	14	GND
2	X0-	15	X0+
3	X1-	16	X1+
4	X2-	17	X2+
5	Xclk-	18	Xclk+
6	X3-	19	X3+
7	SerTC+	20	SerTC-
8	SerTFG-	21	SerTFG+
9	CC1-(TRG)	22	CC1+(TRG)
10	CC2+	23	CC2-
11	CC3-	24	CC3+
12	CC4+	25	CC4-
13	GND	26	+12V

## 1.2 Power-I/O Connector

- HR10A-7R-6PB (Hirose) or equivalent
- This connector is for the power supply (12Vdc) and input /output signals.
- Use HR10A-7P-6S (Hirose) or equivalent for the cable side.

### Pin Assignment

Pin No.	Signal Name	IN / OUT	Voltage		
				Low Voltage	High Voltage
1	GND	IN	0V		
2	I/O-1	IN/OUT	IN	0 to +0.99V	+2.3 to +3.3V
			OUT	0V	+3.3V
3	I/O-2	OUT	OUT	0V	+3.3V
4	I/O-3	OUT	OUT	0V	+3.3V
5	I/O-4	OUT	OUT	0V	+3.3V
6	+12Vdc	IN	+12Vdc		



- Input/output signals can be assigned through the camera setting communication (see table 4).
- Trigger input signal can be assigned either on Camera Link connector (CC1) or on the No. 2 pin of the power-I/O connector through the camera setting communication.

### IO Signal Patterns

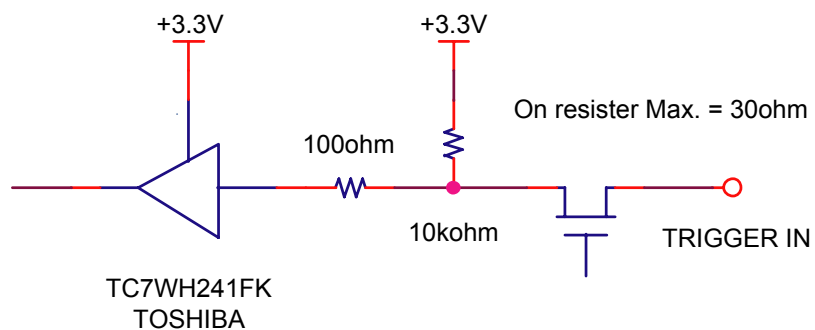
	Command No.	HR10A-7R-6PB (Hirose)			
	F0H[3..0]	No.2 Pin	No.3 Pin	No.4 Pin	No.5 Pin
		I/O-1 (SP4)	I/O-2 (SP3)	I/O-3 (SP2)	I/O-4 (SP1)
Option 0 (Initial Setting)	0H	IN/TRG	N/A	N/A	OUT/TRG
Option 1	1H	For Test Use Only			
Option 2	2H	OUT/CC4	OUT/CC3	OUT/CC"2	OUT/CC1
Option 3	3H	OUT/FVAL	OUT/XSG	OUT/XSUB	OUT/CC1
Option 4	4H	OUT/FVAL	OUT/LVAL	OUT/ Right Image Data (MSB)	OUT/ Left Image Data (MSB)
Option 5	5H	OUT/XHD (high-active)	OUT/EXPDUR (Exposure)	OUT/TRG	OUT/CC1
Option 6	6H	OUT/VD	N/A	N/A	OUT/HD
Others	7H-FH	For Test Use Only			

Note 1: Output trigger signal has a latency of 30CLK (Approximately 470 nseconds) from input trigger signal.

Note 2: To input trigger signal from the I/O connector, change the setting of 12H.5.

Note 3: EXPDUR becomes high during exposure.

## 1.3 Equivalent Circuit for the Input Pin of the I/O Connector

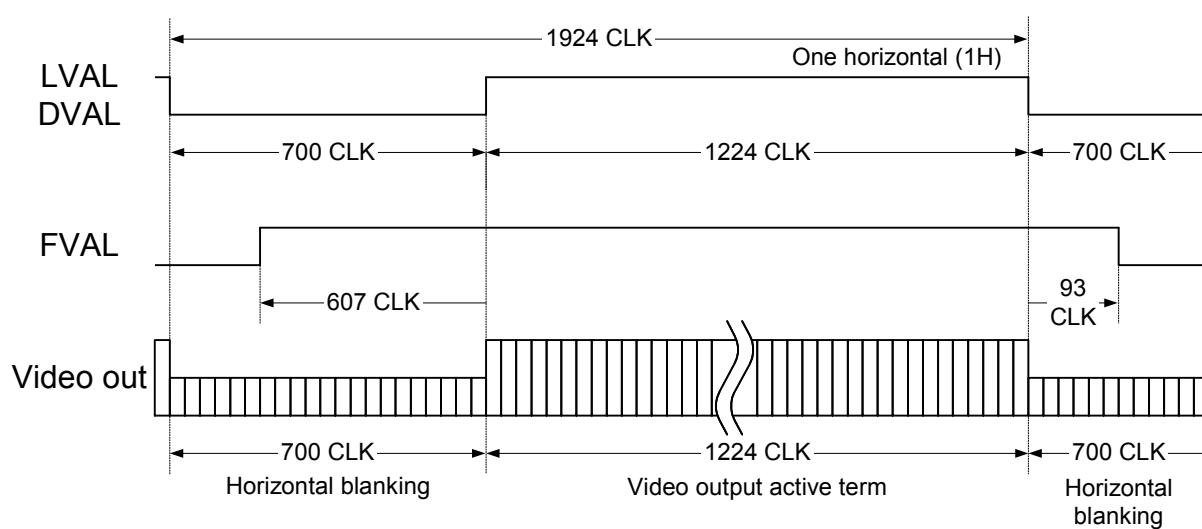


## 2 Camera Output Timing Charts

### 2.1 Normal Mode (Setting 10H: 1XX0XXXX)

#### 2.1.1 Horizontal Timing

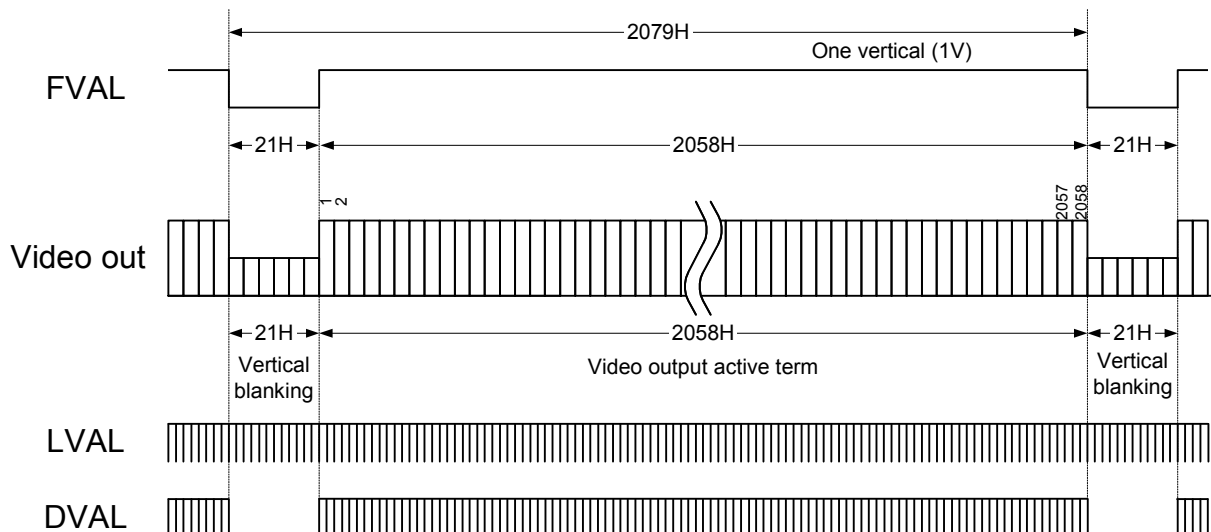
1 CLK = 15.625 ns



## 2.1.2 Vertical Timing

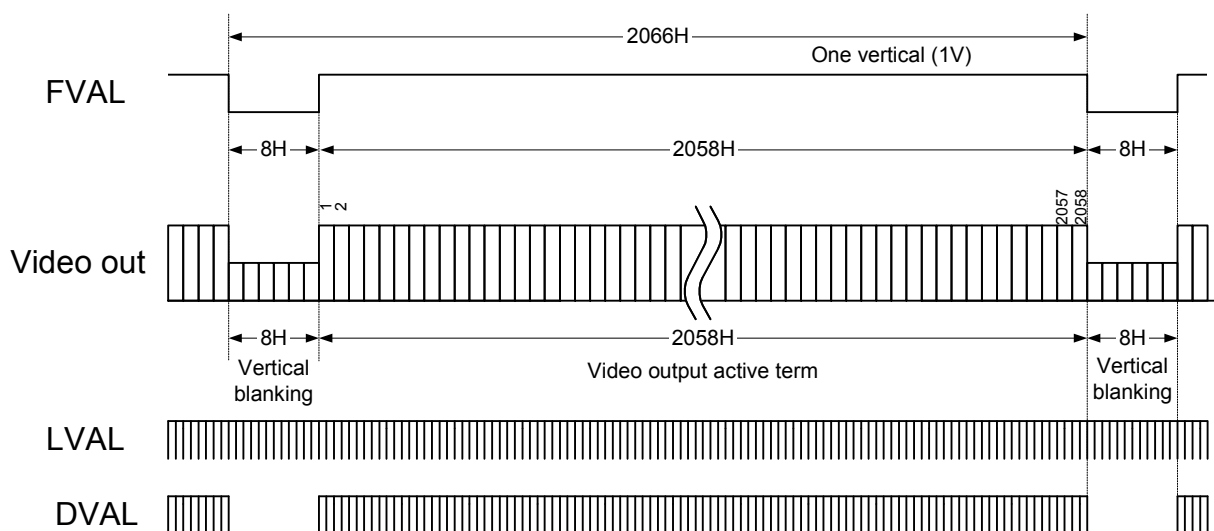
### 2.1.2.1 Normal Full Scanning (Setting 10H: 1XX00XXX, 11H: XXX0X000)

1 H = 30.063  $\mu$ s, 16.000 Hz



### 2.1.2.2 Partial Full Scanning (Setting 10H: 1XX01XXX, 11H: XXX0X000)

1 H = 30.063  $\mu$ s, 16.100 Hz



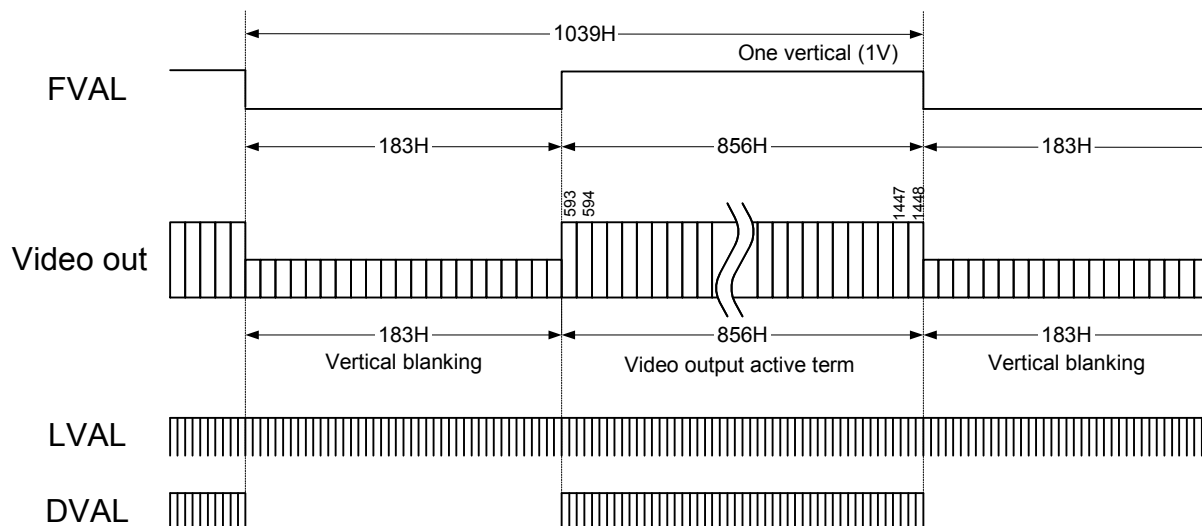
※ By transferring the blanking period pixels at a high rate, the frame rate of the partial full scanning can be increased compared to that of the normal full scanning.

## 2.1.2.3

### 1/2 Partial Scanning

(Setting 10H: 1XX01XXX, 11H: XXX0X001)

1 H = 30.063  $\mu$ s, 32.015 Hz

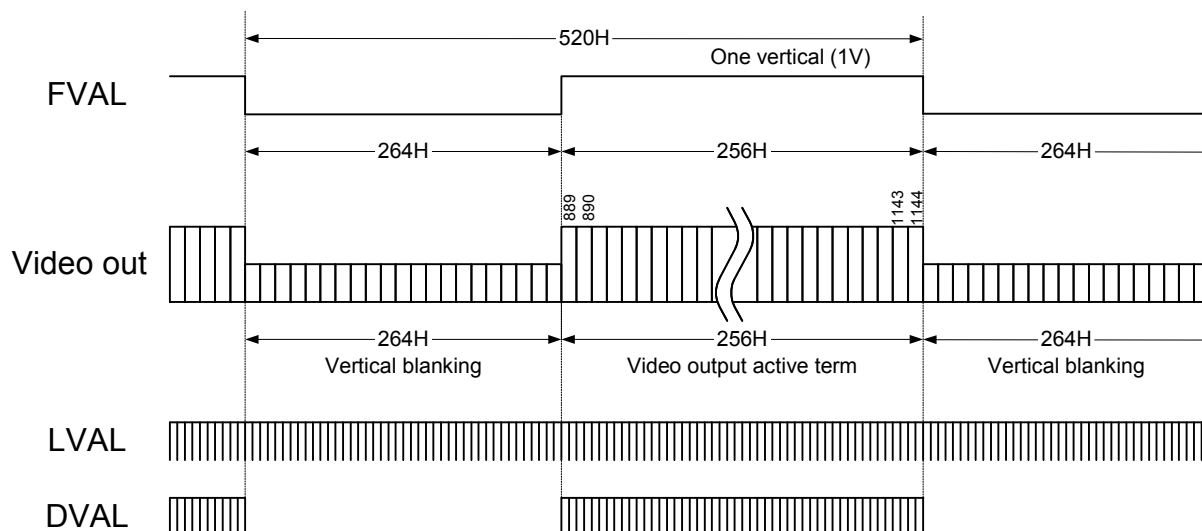


## 2.1.2.4

### 1/4 Partial Scanning

(Setting 10H: 1XX01XXX, 11H: XXX0X010)

1 H = 30.063  $\mu$ s, 63.968 Hz

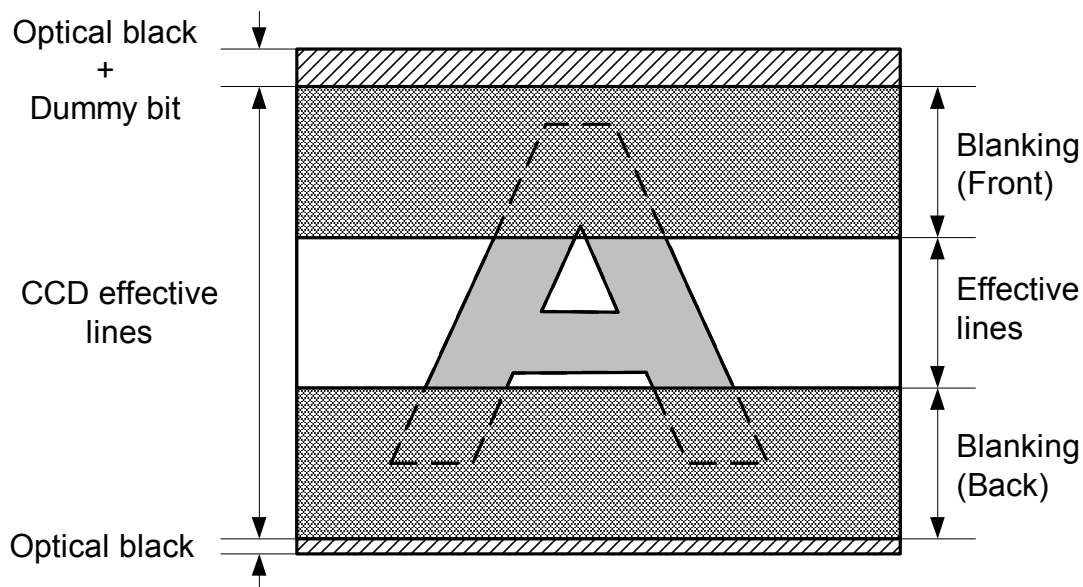
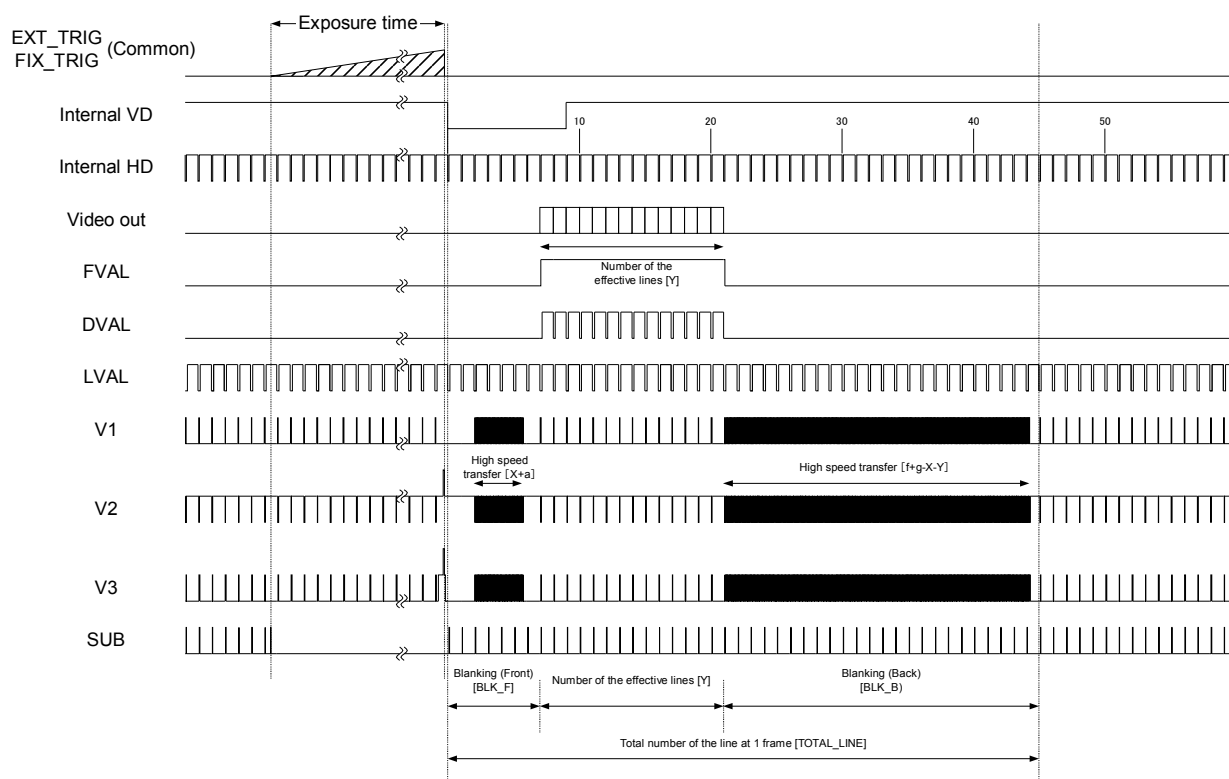




## 2.1.2.5

## Variable Partial Scanning

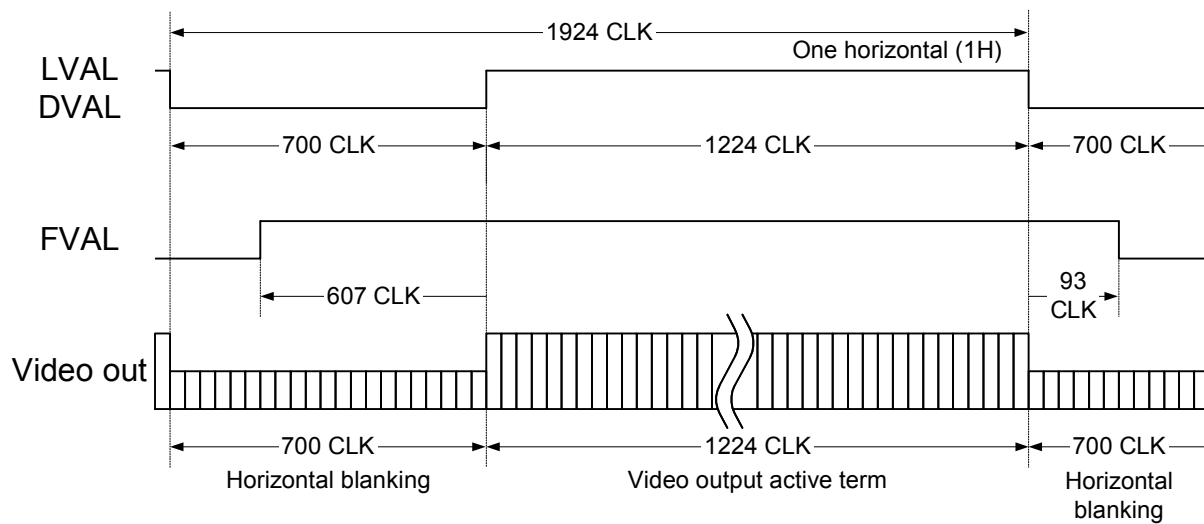
(Setting 10H: 1XX01XXX, 11H: XXX0X111)



## 2.2 Binning Mode (Setting 10H: 1XX1XXXX)

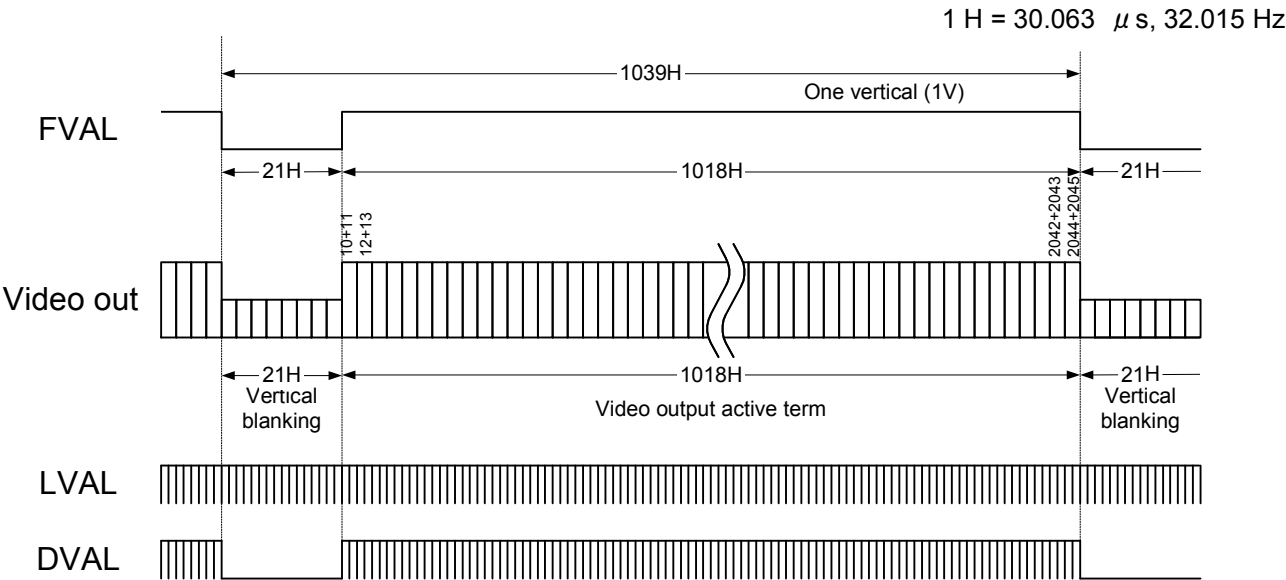
### 2.2.1 Horizontal Timing

1 CLK = 15.625 ns

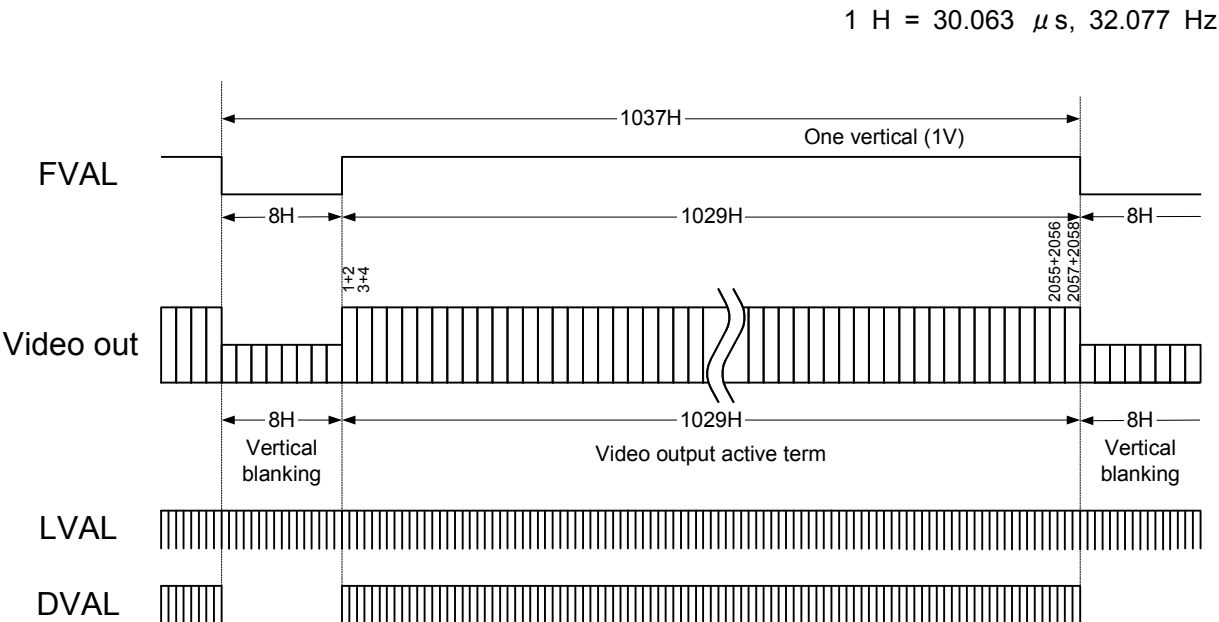


2.2.2 Vertical Timing

2.2.2.1 Binning Full Scanning (Setting 10H: 1XX10XXX, 11H: XXX0X000)



2.2.2.2 Binning Partial Full Scanning (Setting 10H: 1XX11XXX, 11H: XXX0X000)

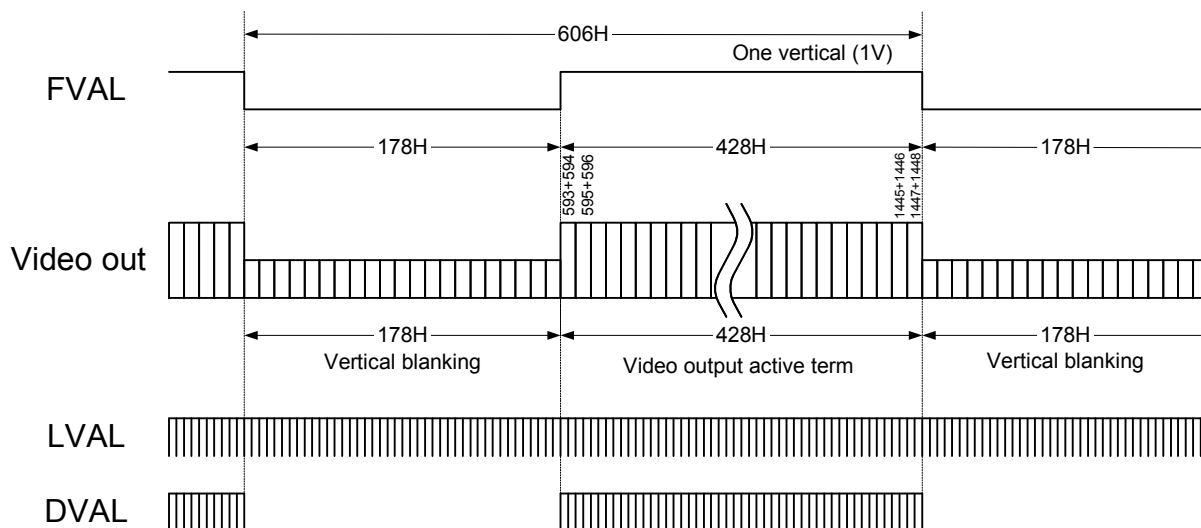


## 2.2.2.3

## Binning 1/2 Partial Scanning

(Setting 10H: 1XX11XXX, 11H: XXX0X001)

1 H = 30.063  $\mu$ s, 54.890 Hz

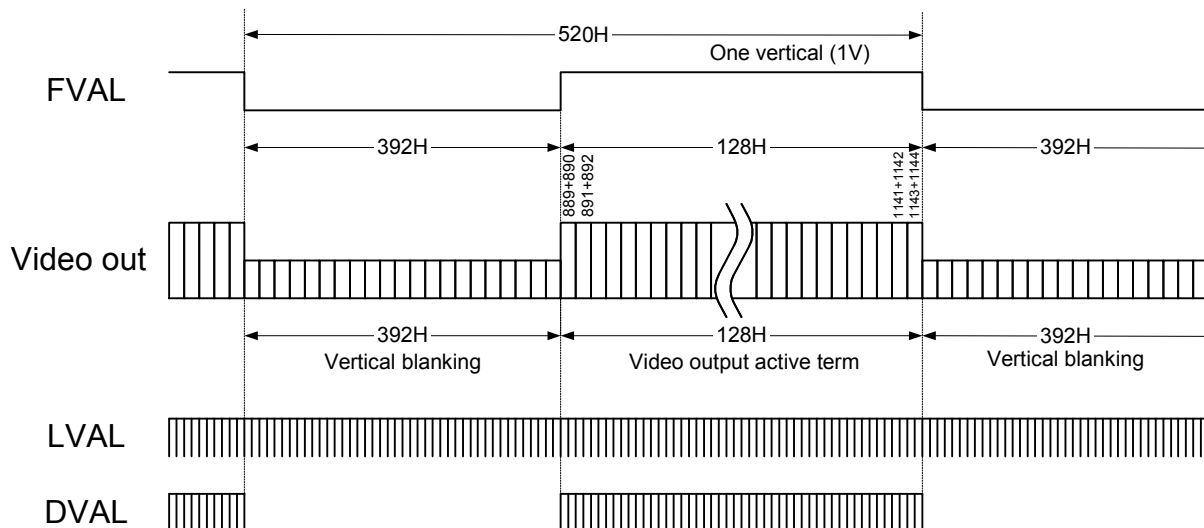


## 2.2.2.4

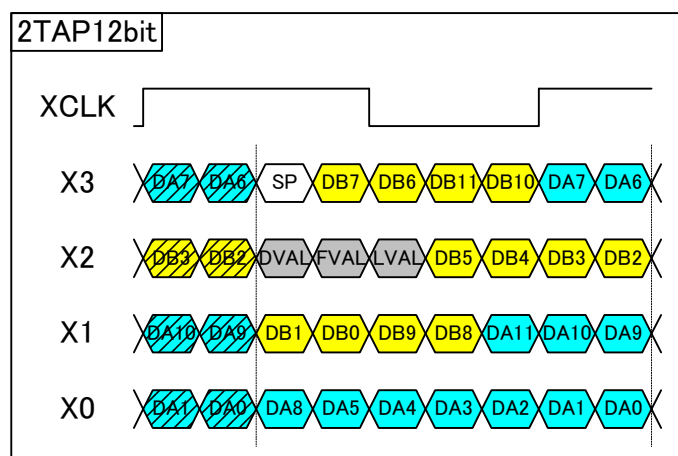
## Binning 1/4 Partial Scanning

(Setting 10H: 1XX11XXX, 11H: XXX0X010)

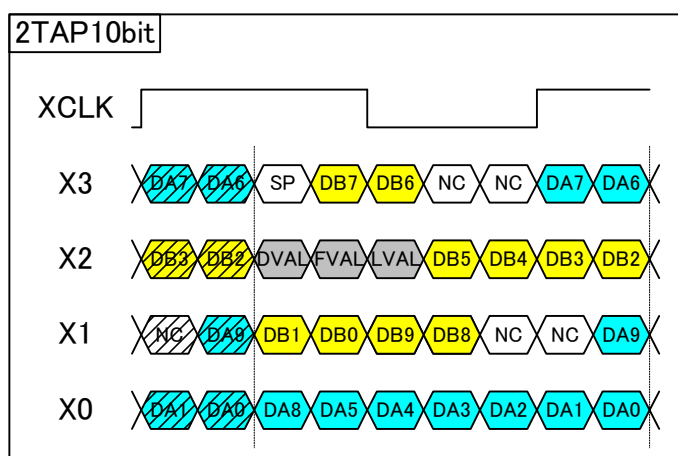
1 H = 30.063  $\mu$ s, 63.968 Hz



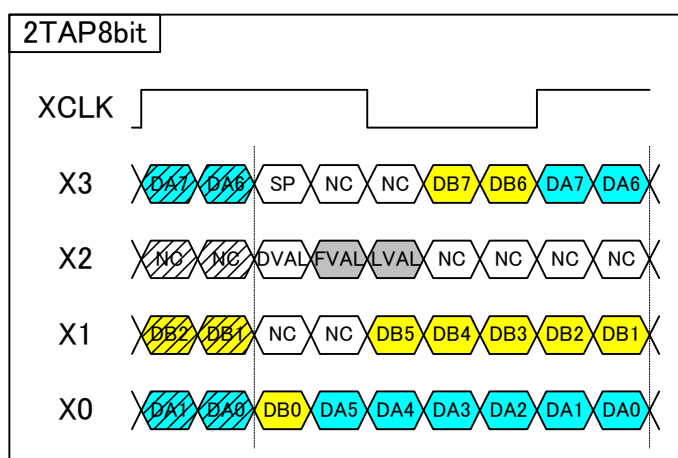
## 2.3 Data Order on the Camera Link Output



DA0 to DA11: 12bit data for one pixel from the first tap  
DB0 to DB11: 12bit data for one pixel from the second tap

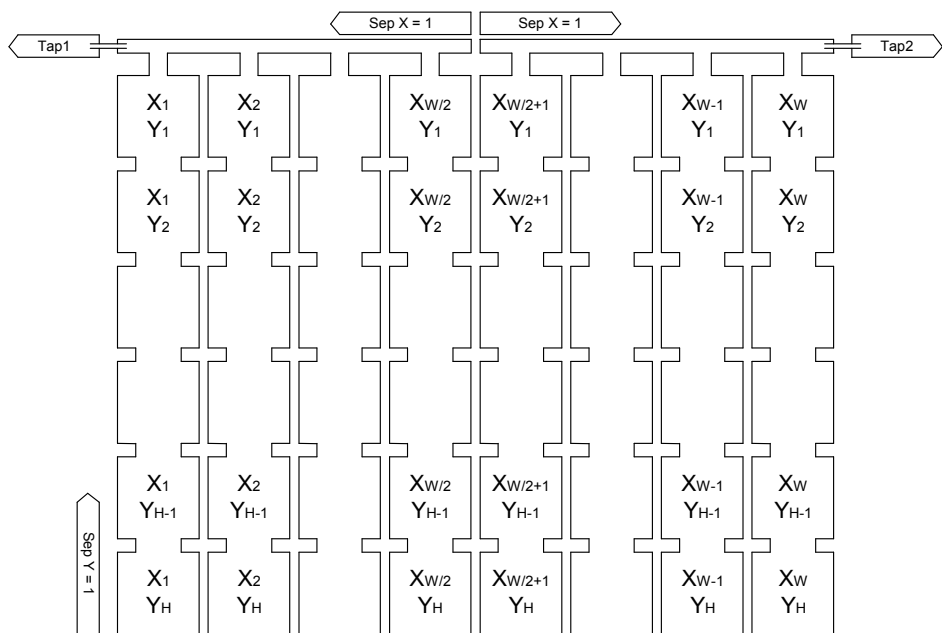


DA0 to DA9: 10bit data for one pixel from the first tap  
DB0 to DB9: 10bit data for one pixel from the second tap

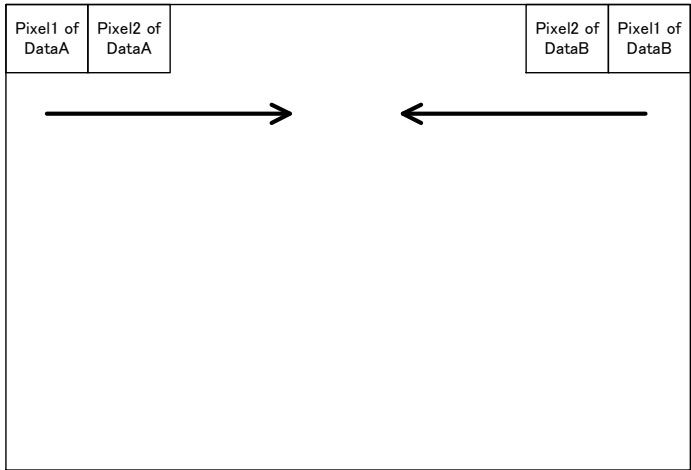


DA0 to DA7: 8bit data for one pixel from the first tap  
DB0 to DB7: 8bit data for one pixel from the second tap

2.4 2 Taps Transferring Image (2XE-1Y)



2.5 Pixel Transferring Image



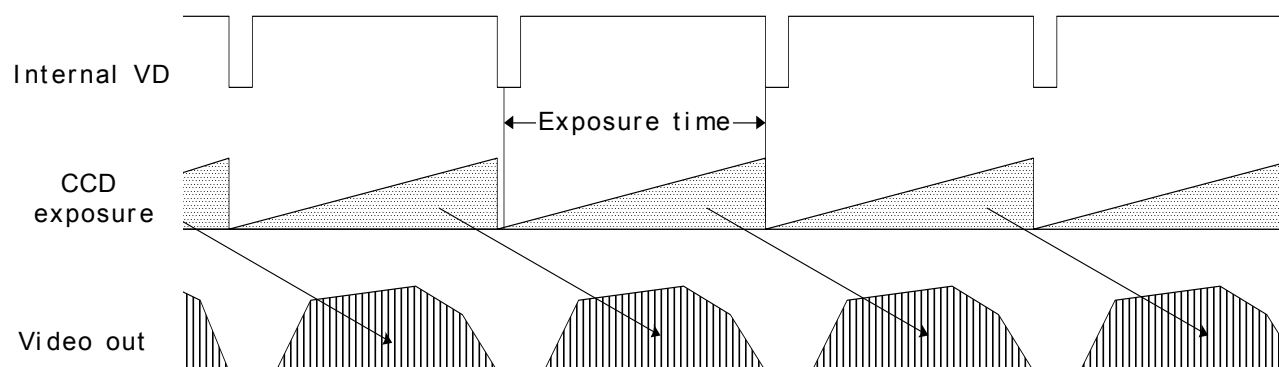
Pixeln of DataA: nth pixel being transferred from the TAP1  
Pixeln of DataB: nth pixel being transferred from the TAP2

## 3 Camera Operational Mode

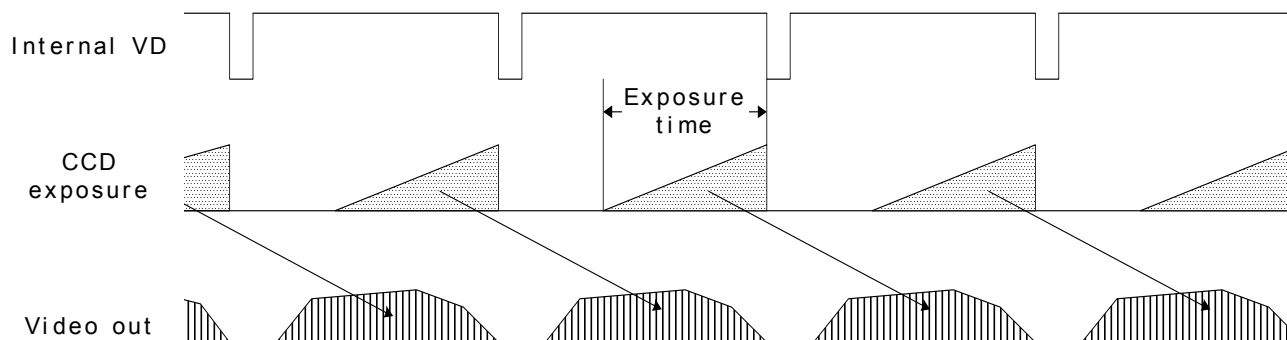
### 3.1 Normal Mode

In this mode, the images are output continuously.

#### 3.1.1 Frame Exposure



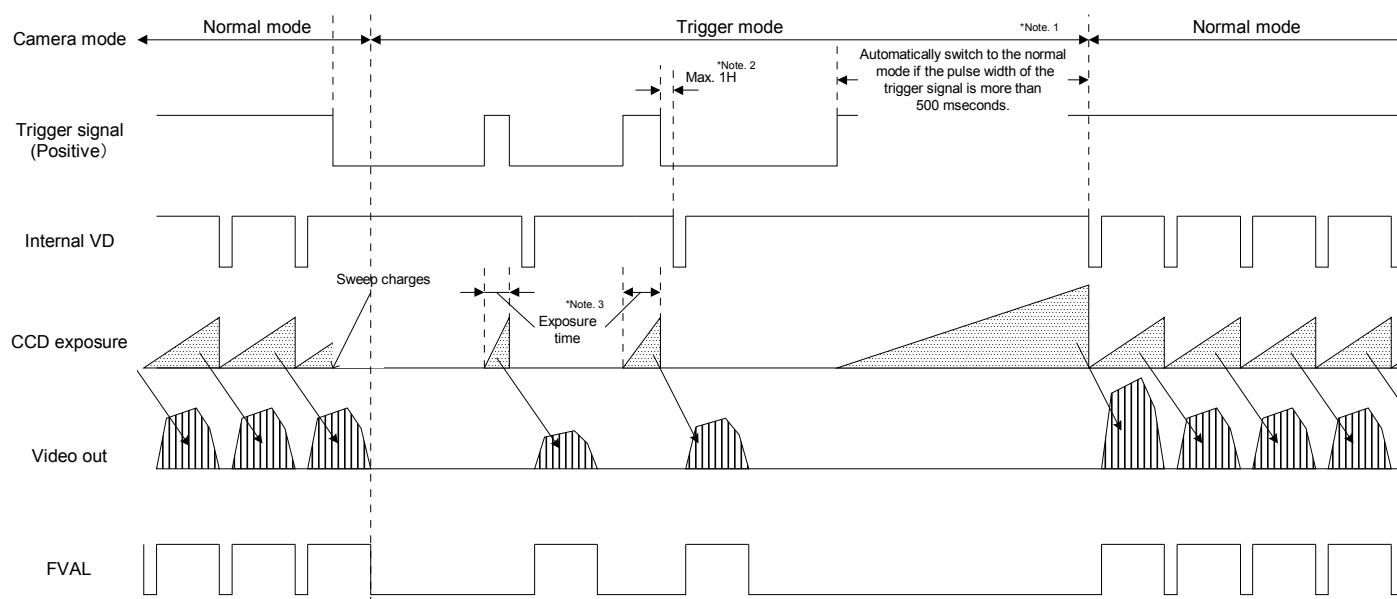
#### 3.1.2 Electric Shutter



## 3.2 Pulse Width Trigger Mode

In this “pulse width trigger mode” with positive polarity, the camera exposure starts at the rising edge of the trigger signal and stops at the falling edge of the trigger signal. Therefore, in the case that the exposure positive polarity is selected, the actual exposure occurs when the trigger signal is at high state.

### 3.2.1 Pulse Width Trigger Mode (V-Reset)



Note 1: The camera does NOT switch to normal mode when the long exposure mode is selected.

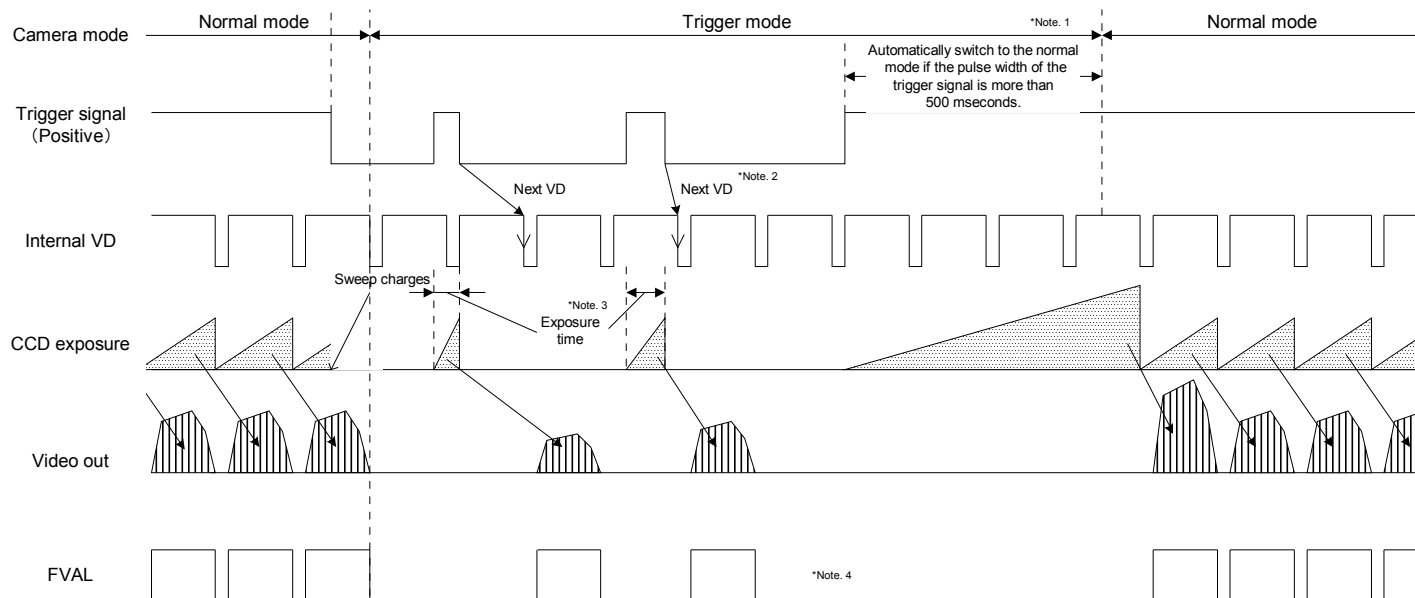
This timing chart shows when the long exposure mode selected.

Note 2: The internal VD signal is reset immediately after the exposure is finished as depicted, and the video output original is sent out according to that reset VD timing.

Note 3: The exposure time is controlled by the pulse width of the trigger signal as depicted.



## 3.2.2 Pulse Width Trigger Mode (Non-Reset)



Note 1: The camera does NOT switch to normal mode when the long exposure mode is selected.

This timing chart shows with the long exposure mode selected.

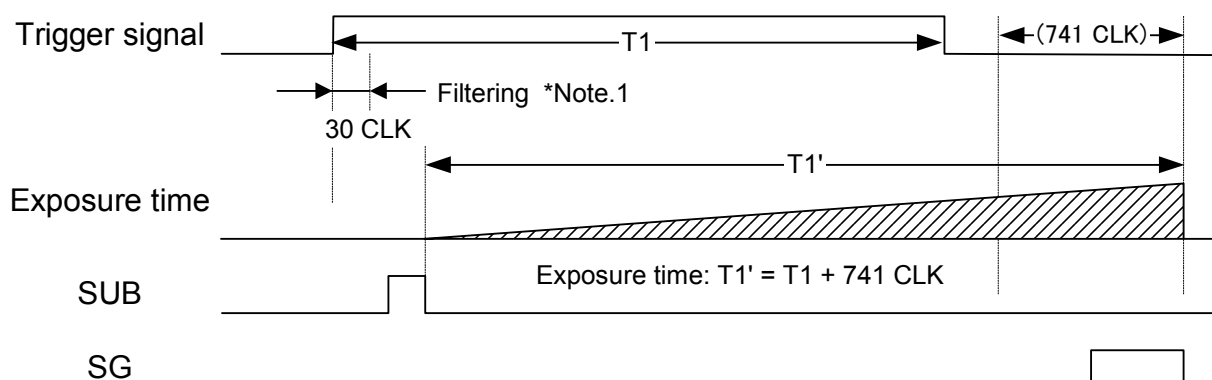
Note 2: The internal VD signal does not reset by the trigger signal.

The video output signal is sent out at the next internal VD timing.

Note 3: The exposure time is controlled by the pulse width of the trigger signal as depicted.

Note 4: The FVAL signal does not output when the exposure by the trigger signal does not exists.

## 3.2.3 Exposure Timing



Notes: The trigger signal equal to or shorter than 30 CLK is removed by the filtering system.

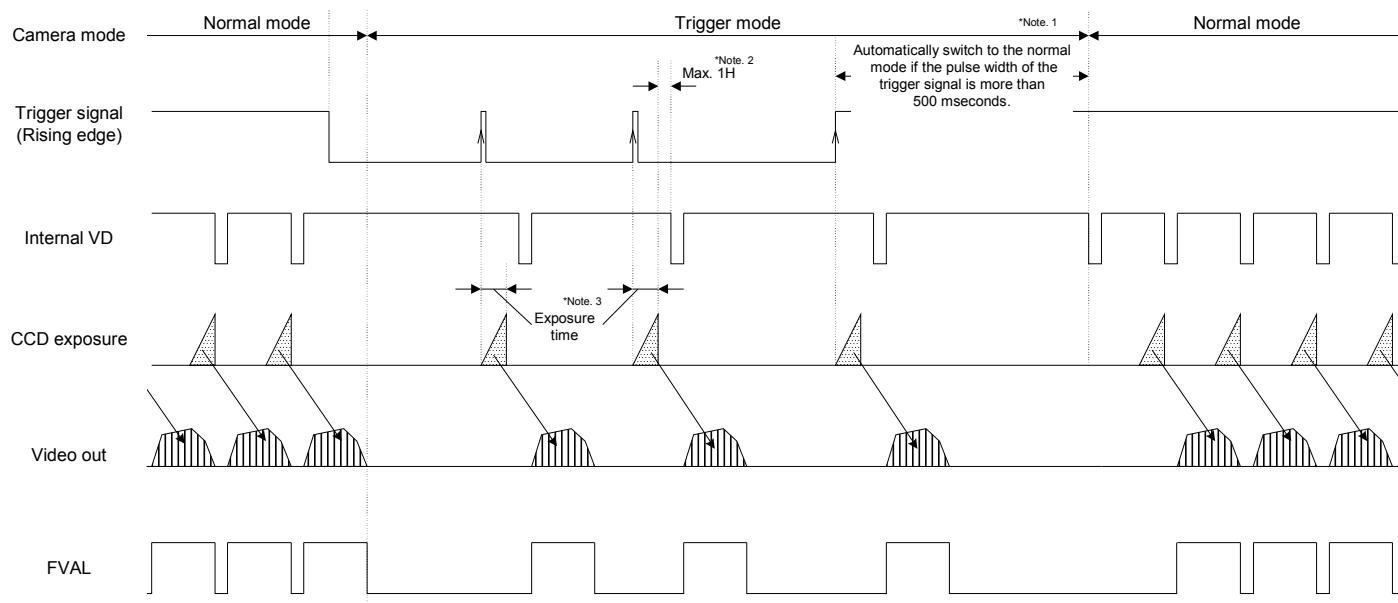
Input trigger signal has to be more than 31 CLK pulse width.

The exposure starts 198 CLK after the rising edge of the trigger signal.

## 3.3 Edge Preset Trigger Mode

In this “edge preset trigger mode”, the camera exposure starts at the rising edge of the trigger signal like the “pulse width trigger mode” in the previous sections. However, in this mode, the exposure duration time is based on the preset value stored by the by the camera setting communication.

### 3.3.1 Edge Preset Trigger Mode (V-Reset)



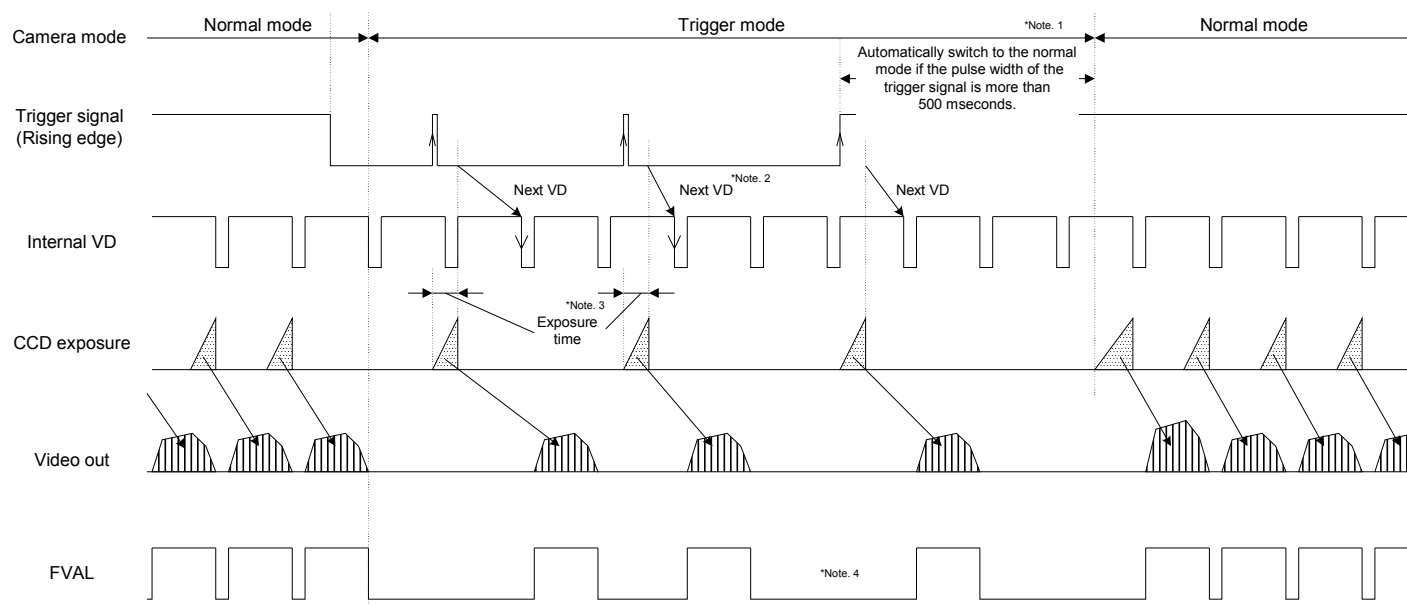
Note 1: The camera does NOT switch to the normal mode when the long exposure mode is selected.

This timing chart shows when the long exposure mode is selected.

Note 2: The internal VD signal is reset immediately after the exposure is finished as depicted and the video output signal is sent out according to the reset VD timing.

Note 3: The exposure time is preset by the camera setting communication as “shutter speed”.

## 3.3.2 Edge Preset Trigger Mode (Non-Reset)



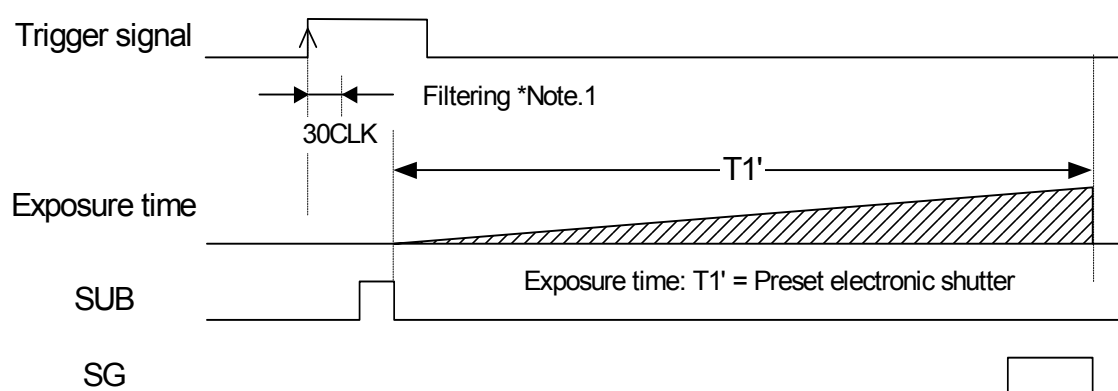
Note 1: The camera does NOT switch to normal mode when the long exposure mode is selected.  
This timing chart shows when the long exposure mode selected.

Note 2: The internal VD signal does not reset by the trigger signal.  
The video output signal is sent out at the next internal VD timing.

Note 3: The exposure time is preset by the camera setting communication as "shutter speed".

Note 4: The FVAL signal does not output when the exposure by the trigger signal does not exist.

## 3.3.3 Exposure Timing



Notes: The trigger signal equal to or shorter than 30 CLK is removed by the filtering system.

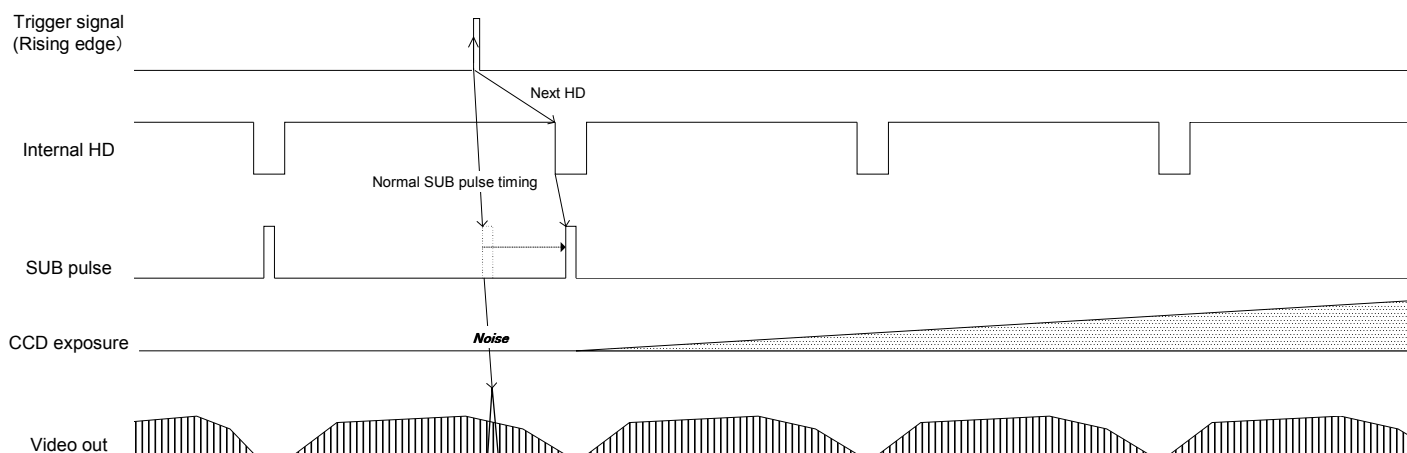
Input trigger signal has to be more than 31 CLK pulse width.

The exposure starts 198 CLK after the rising edge of the trigger signal.

## 3.4 H Reset Mode

Normally, video noise appears when the beginning of trigger signal is applied before finishing the video read-out of the previous frame. This noise is caused by the SUB pulse, which is activated to clear all residual charges on the CCD prior to a new exposure. By selecting this "H. Reset Mode", the camera automatically holds the actual activation of trigger until the next horizontal blanking period. By doing this, the SUB pulse is activated during the horizontal blanking period and the noise in image can be avoided.

Due to the principal of this operation, there can be maximum "1 H" of delay of actual trigger signal.



## 4 Communication Protocol

This camera has a communication function that enables external devices, such as a PC, to control the camera's functions.

Please use the "R-GigE-Software" communication software, or the following communication protocol to communicate to the camera:

### 4.1 Communication Method

UART (RS232C) , binary communication

### 4.2 Communication Settings

	Settings
Baud Rate	9,600 bps / 38,400 bps
Data Bit	8 bit
Parity	None
Stop Bit	1 bit
Flow Control	None

### 4.3 Communication Format

The Sending data format from the PC to the camera is as follows:

SOF	Device Code	Read/Write	Page Selection	Command Code	Data Length	Data	EOF
(8bit)	(6bit)	(1bit)	(1bit)	(8bit)	(8bit)	(R: 1 byte) (W: n bytes)	(8bit)

The Receiving Data format from the camera is as follows:

- After sending the Read Command:

SOF	Data Length	Data	EOF
(8bit)	(8bit)	(n bytes)	(8bit)

- After sending the Write Command:

SOF	Data Length	Receiving Code	EOF
(8bit)	(8bit) "00"	(1 byte)	(8bit)

The description of the format is as follows.

Name	Descriptions
SOF	Start of Frame. Always set or receive the value as "02H"
Device Code	<p>This indicates the destination of communication.</p> <p>Set "000000" when accessing the camera's function settings  Set "100000" when accessing the camera's extended function settings.  Please refer to the "Camera Command List" and "Description of the Camera Control Commands".</p>
Read / Write	<p>This specifies "Read" or "Write" to command numbers.</p> <p>Set (or receive) "0" to send the read command.  Set (or receive) "1" to send the write command.</p>
Page Selection	<p>This specifies page selection (access selection to registers or EEPROM) of command.</p> <p>Set "0" to access the command register of the camera.  Read command: To obtain the current data from the command register.  Write command: To set a data into the command register.  <u>The previously stored data is replaced by this data. However, the data in the EEPROM is not replaced.</u></p> <p>Set "1" to access the EEPROM of the camera.  Read command: To read stored data from the EEPROM.  Write command: To store data into the EEPROM as default value.  The camera returns the receiving code "01H" to the PC after storing data in the EEPROM.</p>
Command Code	This indicates the contents of the data sent or received. Refer to the following page for the details.
Data Length	<p>This indicates the data length (unit: byte).</p> <p>Receiving Frame:  The data length is dependent on each read command sent.  The data length is defined as "00H" when sending the write command.  The data length of error response is defined as "00H".</p> <p>Sending frame:  The data length is 1 byte dummy data when sending the read command, and that data is not referenced.  The data length is dependent on each "write command" sent.</p>
Data	This indicates write data or read data according to command type.
EOF	End of Frame. Always set or receive the value as "03H"
Receiving Code	<p>This indicates results of the command sent</p> <p>01H: OK (ACK), 10H: NG (NAC),  11H: Connection error with peripheral device</p>

## 【Example Code】 Reading the data from the command 00H

- Command to send: 02H, 00H, 00H, 01H, 00H, 03H

SOF	Device Code	Read/Write	Page Selection	Command Code	Data Length	Data	EOF
(8bit)	(6bit)	(1bit)	(1bit)	(8bit)	(8bit)	(1byte)	(8bit)
02H	00H			00H	01H	00H	03H

- Command to receive upon a successful communication: 02H, 01H, 00H, 03H (assuming the data is 00H)

SOF	Data Length	Data	EOF
(8bit)	(8bit)	(n bytes)	(8bit)
02H	01H	00H	03H

## 【Sequence for the saving commands to the EEPROM】

Please use the following sequence for saving the commands to the EEPROM.

- 1) Set “1” to the 80H.0 to enable writing to the EEPROM.
- 2) Send the save data with the page selection “1”.
- 3) The camera sends back one of the following receiving codes after writing the EEPROM.  
01H: OK  
10H: NG
- 4) 80.0H is cleared to “0” automatically after writing the EEPROM.

Note1: The data cannot be saved to the EEPROM when 80H.0 is “0”.

Note2: When saving the consecutive sequence of commands, the above steps, 1) to 4), are necessary only once.

i.e.) saving the commands “10H, 11H, 12H, 13H”, or “22H, 23H, 24H”, etc.

Note3: When saving the non-consecutive sequence of commands, the above steps, 1) to 4), are necessary for the same number of times.

i.e.) saving the commands “10H, 13H, 19H, 1BH” or “20H, 23H, 25H”, etc.

## 4.4 Camera Control Command

### 4.4.1 Camera Command List

- The data unit of the each command is 1 byte (8bit).
- The data can be saved to the EEPROM if there is an "X" in the "Save to EEPROM" column in the following list.
- The camera initializes based on the stored data in the EEPROM when the power is applied.

Command No.	R/W	Save to EEPROM	Function	Initial Data	Data Range
00 to 0FH			<i>Reserved</i>	-	-
10H	R/W	X	<i>Camera function mode 1 (8bit: D[7...0])</i>	9	
11H	R/W	X	<i>Camera function mode 2 (8bit: D[7...0])</i>	0	
12H	R/W	X	<i>Camera function mode 3 (8bit: D[7...0])</i>	0	
13H			<i>Reserved</i>	-	-
14H	R/W	X	<i>Communication mode (8bit: D[7...0])</i>	1	
15 to 1FH			<i>Reserved</i>	-	-
20H	R/W	X	<i>Exposure time (H) of the electronic shutter (16bit: D[7...0])</i>	0	0 to 4095
21H	R/W	X	<i>Exposure time (H) of the electronic shutter (16bit: D[15...8])</i>		
22H	R/W	X	<i>Exposure time (CLK) of the electronic shutter (16bit: D[7...0])</i>	0	0 to 1923
23H	R/W	X	<i>Exposure time (CLK) of the electronic shutter (16bit: D[15...8])</i>		
24H	R/W	X	<i>Start line of the variable partial scanning (16bit: D[7...0])</i>	0	0 to 2057
25H	R/W	X	<i>Start line of the variable partial scanning (16bit: D[15...8])</i>		
26H	R/W	X	<i>Effective lines of the variable partial scanning (16bit: D[7...0])</i>	2058	0 to 2058
27H	R/W	X	<i>Effective lines of the variable partial scanning (16bit: D[15...8])</i>		
28H	R/W	X	<i>Delay time for the trigger (8bit: D[7...0])</i>	0	0 to 31
29-2FH			<i>Reserved</i>	-	-
30H	R/W	X	<i>CDS gain (8bit: D[7...0])</i>	0	0 to 255
31H		X	<i>Digital gain</i>	The Factory Adjusted Value	0 to 255
32H	R/W	X	<i>Gain offset (6bit: D[5...0])</i>		0 to 255
33 to 37H			<i>Reserved</i>	-	-
38H	R/W	X	<i>Clamp level (8bit: D[7...0])</i>	0	0 to 255
39 to 3DH			<i>Reserved</i>	-	-
3EH	R/W	X	<i>Test pattern level (10bit: D[7...0])</i>	4095	0 to 4095
3FH	R/W	X	<i>Test pattern level (10bit: D[9...8])</i>		
40 to 53H	R/W	X	<i>Reserved</i>	-	-
68H	R/W	X	<i>Digital clamp (8bit: D[7..0])</i>	0	
69H			<i>Reserved</i>	-	-
6AH	R/W	X	<i>Manual digital clamp (Left) (16bit D[7..0])</i>	0	0 to 1023
6BH	R/W	X	<i>Manual digital clamp (Left) (16bit D[15..8])</i>		
6CH	R/W	X	<i>Manual digital clamp (Right) (16bit D[7..0])</i>	0	0 to 1023
6DH	R/W	X	<i>Manual digital clamp (Right) (16bit D[15..8])</i>		
6E to 77H			<i>Reserved</i>	-	-
78H	R/W	X	<i>Test pattern selection (8bit: D[7..0])</i>	0	-
79H	R/W	X	<i>Image effect selection (8bit: D[7..0])</i>	0	-
7A to FFH			<i>Reserved</i>	-	-
80H	R/W		<i>EEPROM control (8bit: D[7...0])</i>		



81 to EFH			<i>Reserved</i>	-	-
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Command No.	R/W	Save to EEPROM	Function	Initial Data	Data Range
F0H	R/W		<i>IO connector signals(8bit: D[7...0])</i>		
F1 to FFH			<i>Reserved</i>	-	-

## 4.4.2 Descriptions of the Camera Control Commands

(The underline settings are the factory default settings)

Command No.	Command Descriptions								
10H: MOD1[7...0]	<p>[Camera function mode setting 1] Initial data: 09H This sets the following camera function mode.</p> <p>D[7...0]</p> <table><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table> <p>D7: Continuous / Trigger Mode      <u>0: Auto</u>      1: Manual D6: Trigger Polarity      <u>0: Positive</u>      1: Negative D5: Trigger Mode      <u>0: Edge Preset</u>      1: Pulse Width D4: Binning Mode      <u>0: OFF (Normal)</u>      1: ON (Binning) D3: Scanning Mode      0: Full scanning      <u>1: Partial scanning</u> D2~D0: Reset Mode      000: Non-Reset      <u>001: V-Reset</u> 010~111: No function (Prohibited setting. Please do not use these)</p> <p>When D7 is set to “0: Auto”, a camera will detect its operational mode based on the input trigger signal. If the input trigger signal is kept at high, the camera operates in the continuous mode, assuming the trigger polarity is set to positive.</p>	D7	D6	D5	D4	D3	D2	D1	D0
D7	D6	D5	D4	D3	D2	D1	D0		
11H: MOD2[7...0]	<p>[Camera function mode setting 2] Initial data: 0 This sets the following camera function modes.</p> <p>D[7...0]</p> <table><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table> <p>D7~D4: No Function      Set always “0000” D3: Function Mode      <u>0: Trigger</u>      1: Normal D2~D0: Partial Scanning      <u>000: Full scanning</u>      001: 1/2 partial scanning 010: 1/4 partial scanning 011~110: No function (Prohibited setting. Do not set these values) 111: Variable partial scanning</p> <p>Function mode is enabled when the “Continuous/Trigger” mode selection (MOD[7] is manual (set as 1). No video output without the trigger signal input while the camera works with the trigger mode.</p>	D7	D6	D5	D4	D3	D2	D1	D0
D7	D6	D5	D4	D3	D2	D1	D0		
12H: MOD3[7...0]	<p>[Camera function mode setting 3] Initial data: 0 This sets the following camera function modes.</p> <p>D[7...0]</p> <table><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table> <p>D7~D6: Video Out      <u>00: 10bit</u>      01: 8bit 10: 12bit 11: No function (Prohibited setting. Do not set these values) D5: Trigger-in connector selection      <u>0: Camera Link (CC1)</u>      1: /IO connector (No.2 Pin) D4~D3: Exposure Start Mode      <u>00: Normal</u>      01: Reserved trigger 10 ~11: H reset D2~D0: No Function      <u>Set always “000”</u></p>	D7	D6	D5	D4	D3	D2	D1	D0
D7	D6	D5	D4	D3	D2	D1	D0		

Command No.	Command Descriptions								
14H: UART[7...0]	<p>[Communication mode] Initial Data: 01H This sets the communication modes. D[7...0]</p> <table border="1"><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table> <p>D7~D2:      No Function      <u>Set always "000000"</u> D1~D0:      Communication Mode      00: 38,400 bps      <u>01: 9,600 bps</u> 10 to 11: No function (Prohibited setting. Do not set these values)</p>	D7	D6	D5	D4	D3	D2	D1	D0
D7	D6	D5	D4	D3	D2	D1	D0		
20H: SVR[7...0] 21H: SVR[15...8]	<p>[Exposure time (H) of the electronic shutter] Initial Data: SVR[15...0] = 0, Data Range: 0 to 4095 Sets the preset shutter speed (or CCD exposure time) for electronic shutter.</p> <p>The preset shutter speed is defined by the following formula. Exposure time (shutter speed) = SVR[15...0] x (1H cycle time) + SHR[15...0] x (1CLK cycle time)</p> <p>Notes:</p> <ol style="list-style-type: none"><li>1. The camera works with the shutter off position (maximum frame exposure time) when both SVR and SHR are set at "0".</li><li>2. The camera works with the minimum shutter speed when this value is set to 0 and the value of SHR is set between 1 and 600.</li><li>3. The value is replaced with 4095 automatically when the value set greater than 4095.</li></ol>								
22H: SHR[7...0] 23H: SHR[15...8]	<p>[Exposure time (CLK) of the electronic shutter] Initial Data: SHR[15...0] = 0, Data Range: 0 to 1923 Sets the preset shutter speed (or CCD exposure time) for electronic shutter.</p> <p>The previous section, the preset shutter speed is defined by the following formula: Preset shutter speed = SVR[15...0] x (1H cycle time) + SHR[15...0] x (1CLK cycle time)</p> <p>Notes:</p> <ol style="list-style-type: none"><li>1. The camera works with the shutter off position (maximum frame exposure time) when both SVR and SHR are set at "0".</li><li>2. The camera works with the minimum shutter speed when SVR is set to 0 and this value is set between 1 and 600.</li><li>3. The value replaces by 1923 automatically when the value set greater than 1923.</li></ol>								
24H: PSR[7..0] 25H: PSR[15...8]	<p>[Start line of the variable partial scanning] Initial Data: PSR[15...0] = 0, Data Range: 0 to 2057 This sets the start line number of the variable partial scanning area.</p> <p>Actual start line of the partial scanning = this value + 1</p> <p>Notes:</p> <ol style="list-style-type: none"><li>1. The value replaces by 2057 automatically when the value set greater than 2057.</li><li>2. The camera works with full scanning mode when the value of (PSR[ ] + PWR[ ]) is greater than 2058.</li></ol>								

Command No.	Command Descriptions
26H: PWR[7...0] 27H: PWR[15...8]	<p>[Effective line numbers in the variable partial scanning] Initial Data: PWR[15...0] = 2058, Data Range: 0 to 2058 This sets the number of the total effective lines (image height) in the variable partial scanning mode.</p> <p>Notes:</p> <ol style="list-style-type: none"> <li>1. The value replaces by 2058 automatically when the value set greater than 2058.</li> <li>2. The camera works with full scanning mode when the value of (PSR[ ] + PWR[ ]) is greater than 2058.</li> </ol>
28H: DLY[7...0]	<p>[Delay time for the trigger] Initial Data: DLY[7...0] = 0, Data Range: 0 to 255 Sets the delay time from the trigger input signal to the start of the exposure.</p> <p>Delay time (us) = 128 x CLK x DLY[7...0] = 2.000 (us) x DLY[7...0], where CLK = pixel clock</p>
30H PGA[7...0]	<p>[CDS gain] Initial Data: PGA[7...0] = 0, data range: 0 to 255 Sets the CDS gain (programmable analog gain).</p> <p>CDS gain = 11.1 + 0.0359 x (PGA[7..0] x 2 + GOFS[7..0]) (dB) *GOFS[7...0]: The gain offset (The value of the address 32H)</p>
31H DGB[7...0]	<p>[Digital gain] Initial Data: The factory adjusted value, Data Range: 0 to 255 Sets the digital gain.</p> <p>Output level = (input level – CLAMP[7...0] x 16 – (CDS_CLAMP_L[9..0] + CDS_CLAMP_R[9..0]) / 2) x (1 + (DGB[7..0] + GOFS[7..0]) / 128) + CLAMP[7..0] X 16 + (CDS_CLAMP_L[9..0] + CDS_CLAMP_R[9..0]) / 2</p> <p>*CLAMP[7...0]: clamp level (command no. 38H) *GOFS[7...0]: gain offset (command no. 32H) *CDS_CLAMP_L[9...0]: CDS clamp left (command no. CC-CDH) *CDS_CLAMP_R[9...0]: CDS clamp right (command no. CE~CFH)</p>
32H GOFS[7...0]	<p>[Gain offset] Initial Data: The factory adjusted value, Data Range: 0 to 255</p>
38H: CLAMP[7...0]	<p>[Clamp level] Initial Data: CLAMP[7...0] = 0, Data Range: 0 to 31 This sets the clamp level value of the black level.</p> <p>Clamp level (Left) = CLAMP[7..0] x 16 + CDS Clamp (Left) Clamp level (Right) = CLAMP[7...0] x 16 + CDS Clamp (Right)</p> <p>The value replaces by 31 automatically when the value set greater than 31.</p>
3EH: TP0[7...0] 3FH: TP0[9...8]	<p>[Test pattern level] Initial data: 4095, data range: 0 to 4095 Sets the output level of the test pattern 4: Raster (variable level) in 10-bit output format.</p>

Command No.	Command Descriptions								
68H: DIGITAL_ CLAMP[7...0]	<p>[Digital clamp] Initial data: DIGITAL_CLAMP[7..0] = 0 Sets the digital clamp. D[7..0]</p> <table><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table> <p>D7 to D5:      No function      <u>Always set as “000”</u> D4:              Mirror image      <u>0: Normal image</u>      1: Mirror image D3:              No function      <u>Always set as “0”</u> D2:              Clamp mode      <u>0: Auto adjust</u>      1: Manual adjust D1 to D0:      No function      Always set as “00”</p> <p>The following two settings have to be set when the “manual adjust” is selected at the clamp mode: Manual digital clamp (Left): MD_CLAMP_L[15..0] (6A &amp; 6BH) Manual digital clamp (Right): MD_CLAMP_R[15..0] (6C &amp; 6DH)</p>	D7	D6	D5	D4	D3	D2	D1	D0
D7	D6	D5	D4	D3	D2	D1	D0		
6AH: MD_CLAMP_L [7...0] 6BH: MD_CLAMP_L [15...8]	<p>[Manual digital clamp (Left)] Initial data: MD_CLAMP_L[15..0] = The factory adjusted value, data range: 0 to 1023</p> <p>Sets the manual digital clamp for the left side of the image when the manual adjust is selected at the digital clamp (68H).</p>								
6CH: MD_CLAMP_R [7...0] 6DH: MD_CLAMP_R [15...8]	<p>[Manual digital clamp (Right)] Initial data: MD_CLAMP_R[15..0] = The factory adjusted value, data range: 0 to 1023</p> <p>Sets the manual digital clamp for the right side of the image when the manual adjust is selected at the digital clamp (68H).</p>								
78H: TESTP[7...0]	<p>[Test pattern selection] Initial data: TESTP[7..0] = 0 Sets the test pattern output from the camera. D[7..0]</p> <table><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table> <p>00H:      <u>Video output</u>      01H:      Gray scale 02H:      Ramp wave      03H:      Uniform gray level (100% white) 04H:      Uniform gray level (variable level)      05H:      Color bar (RGB bayer) Others:      Black</p>	D7	D6	D5	D4	D3	D2	D1	D0
D7	D6	D5	D4	D3	D2	D1	D0		

Command No.	Command Descriptions								
79H: EFFCT[7...0]	<p>[Image effect selection] Initial data: EFFCT[7..0] = 0 Sets the image effect.</p> <p>D[7..0]</p> <table><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table> <p>00H:            <u>No effect (Original video)</u>    01H:    11bit gradation 02H:            10bit gradation            03H:    9bit gradation 04H:            8bit gradation            05H:    7bit gradation 06H:            6bit gradation            07H:    5bit gradation 08H:            4bit gradation            09H:    3bit gradation 0AH:            2bit gradation            0BH:    1bit gradation 0C to FEH:    No function FFH:            MSB-LSB reverse</p>	D7	D6	D5	D4	D3	D2	D1	D0
D7	D6	D5	D4	D3	D2	D1	D0		
80H: E2P[7...0]	<p>[EEPROM control] Initial data: E2P[7...0] = 0 Sets the image effect.</p> <p>D[7..0]</p> <table><tr><td>D7</td><td>D6</td><td>D5</td><td>D4</td><td>D3</td><td>D2</td><td>D1</td><td>D0</td></tr></table> <p>D7~D2:    No function    </p>	D7	D6	D5	D4	D3	D2	D1	D0
D7	D6	D5	D4	D3	D2	D1	D0		

## 5 Revision History

Rev	Date	Changes	Note
1.00	2012/06/15	Initial Release	
1.01	2012/07/13	Updated Document Title Communication Protocol 78H Test pattern 79H Pasteurization Added 3E-3FH Test pattern variable level	
1.02	2012/09/27	Updated Power-I/O Connector Power supply through No.6 pin of the power-I/O connector became available.	

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